PROCEEDINGS

OF THE

American Fish Culturists' Association

At its Second Annual Meeting, February 11th, 1873.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
1873.

OFFICERS.

WILLIAM CLIFT, - - - President.

MYSTIC BRIDGE, CONN.

A. S. COLLINS, - - - Secretary.

CALEDONIA, N. Y.

B. F. BOWLES, - - - - Treasurer.

SPRINGFIELD, MASS.

REPORT.

The second annual meeting of the American Fish Culturists' Association was held Tuesday, February 11th, 1873, at the office of George Shepard Page, No. 10 Warren street, New York city.

The meeting was called to order by the president at eleven o'clock A. M.

The members present were, W. Clift, A. S. Collins, George Shepard Page, B. F. Bowles, G. W. Chrysler, A. P. Rockwood, E. B. Paxton, B. B. Porter, Joseph Van Cleve.

Among those present who were not members of the association, but who participated in the discussions of the meeting, were Dr. M. C. Edwards, State Fish Commissioner of Vermont, Joseph H. Barden, State Fish Commissioner of Rhode Island, Thaddeus Norris, of Philadelphia, and others.

The record of the last meeting was read and approved.

The report of the treasurer was read and accepted.

The president of the association, Mr. W. Clift, read an address, entitled "The Important Events in Fish Culture during the Year 1872."

The address of the president was followed by the reading of several interesting papers and letters, which are printed with this report.

An informal discussion on various topics relating to fish culture then took place. Mr. E. B. Paxton, of Detroit, gave a highly interesting account of the white fishery of Detroit river, and its decadence in value of late.

On reassembling, after a recess of an hour, it was voted to appoint a committee of three members to make a programme for the next annual meeting. The president appointed Messrs. Collins, Bowles and Page.

It was voted to ask Congress for an appropriation of $30,000 for the promotion of the culture of food fishes.

It was voted to authorize the secretary to procure the printing of the report of the proceedings of the association in 1872, embracing

such papers as he deems advisable, and that a list of the members of the association be included in the next printed report.

The committee chosen to nominate officers for the ensuing year made the following report, which was unanimously accepted: For president, W. Clift; for secretary, A. S. Collins; for treasurer, B. F. Bowles.

The association then adjourned for one year, to meet at the same place, No. 10 Warren street, New York city, on the second Tuesday in February, 1874.

THE PRESIDENT'S ADDRESS.

IMPORTANT EVENTS IN FISH CULTURE DURING THE YEAR 1872.

In the review of the year the most important event is the appropriation made by Congress in its behalf. At the last annual meeting of the American Fish Culturists' Association, held at Albany, February 7th and 8th, 1872, this matter was discussed and a committee was appointed to memorialize Congress for aid. It was felt that the time had come when much larger sums could be used to advantage in the distribution of fish, and that an attempt should be made to introduce the anadromous fishes into the large rivers, over which no State has exclusive control. Mr. George Shepard Page of New York, the chairman of this committee, visited Washington and labored assiduously until he secured an appropriation of $15,000, to be distributed under the direction of Prof. Spencer F. Baird, U. S. Fish Commissioner. Great credit is due to Mr. Page and to his coadjutors in Washington, for the first congressional aid granted to fish culture. The subject was quite thoroughly discussed, and for the first time brought before our senators and representatives as a practical question. Mr. R. B. Roosevelt, of New York city, made a most interesting and lucid speech in behalf of the appropriation, presenting many facts in the history of the art, which had great weight with our representatives. He showed the great interest which western people had in this question. He said "the fisheries of our coast are among the most valuable commercial interests of our country. Millions of money are invested and hundreds of thousands of men are employed, while the food thus obtained is a large per centage of the total supply of eastern markets. Not only is the profit of this business a matter of general advantage, but the residents along the

eastern bays and lagoons and upon the larger rivers derive their principal means of sustenance directly from these waters, and in all of these districts far more families are supported by the water than by the land. In the west there is nothing of this sort. The markets are almost bare of fish; a few catfish, suckers and pickerel constitute the wretched and meager bill of fare they offer. The muddy Mississippi contains little or nothing. The beautiful Ohio has but one or two sorts of pike and perch, which the inhabitants flatteringly call salmon, while catfish hide in most of the discolored streams of our continent, and suckers explore the bottom for their food. If any thing can be done to improve this state of affairs, to make fish and fishermen as abundant in the west as they are in New England, and to develop the same activity in the matter as exists in the east, it is well worth the serious consideration of the government. By this means a new industry, an additional source of income, an entirely different species of food would be introduced, and an immense increase added to the wealth of the whole region of country. There is no reason why the waters of the west should be less prolific than those of the east, provided the right species were introduced; and were trout, salmon, shad, bass and sturgeon to take the place of catfish, pickerel and suckers, the gain would be manifest. It seems to me clearly to be the duty of the government to assist in this very work of introducing new varieties, as well as replenishing the old, where they have been reduced.

"No private person can own a shad which is here to-day and to-morrow in mid-ocean, nor is a single resident on a river's bank sufficiently interested to incur the expense of importing fish for the benefit of his neighbors. This is the nation's duty or it is nobody's. The mighty rivers of the southern and western States, which now generally produce only the poorer sorts, could readily be stocked with the most palatable and prolific varieties. The cost of the undertaking is insignificantly moderate. A salmon hatching-house can be built for $1,000, while the necessary implements for shad raising are too inexpensive to be worth mentioning. Some labor must be employed, but it is mostly unskilled and cheap, while the outlay for transportation is simply the mere charge of express or traveling fare. The people of this country would not grudge this, were it a hundred times as great, with the certain prospect of developing a new food resource, and of diminishing the price of living to the poor."

Mr. Rosevelt deserves the thanks of this association and of all patriotic men for these appreciative words spoken in his place in the House of Representatives, in behalf of this movement for stocking the barren rivers. This appropriation is valuable, not so much for the amount given and for the good work it has enabled Prof. Baird to inaugurate, as for the precedent it has established.

If the enterprises begun shall be successfully developed, there will be little difficulty in securing further appropriations from Congress, and all the money that can be advantageously used will be furnished. The commencement of the artificial stocking of the rivers of the Mississippi valley is another item of interest. The California Fish Commissioners had employed Mr. Seth Green to put Hudson river shad into the Sacramento the previous year, and to the astonishment of all fish breeders, including Mr. Green himself probably, a few thousand did survive the journey and swam in California waters. But the thing was so novel that many doubted whether it could be done again with any amount of skill and watchfulness.

Although the appropriation was not made until June, and the arrangements for the transportation of fry were not completed until the hatching season was nearly closed upon the Hudson, Mr. Green succeeded in planting many thousands of the fry in the Alleghany, at Salamanca, N. Y., and in the Mississippi just below St. Paul.

A still larger number of fry were taken from the Connecticut and planted in the Alleghany at Salamanca, in the White river at Indianapolis and in the far Platte at Denver. I think these experiments demonstrate that shad fry can be planted in all of our great rivers at a very moderate expense, and that the stock can be furnished thereat, from which breeders can be taken for fish hatching establishments upon these rivers a few years hence. The meager planting of a few thousand fry in these streams should not be regarded as the end of the work.

Breeding appliances, like those at Hadley Falls, are wanted near the head-waters of the large rivers, where shad by the hundred million can be turned into the waters.

This work can be done so cheaply that it is only necessary to demonstrate that shad will certainly return to their hatching grounds to make the States threaded by these rivers eager to help the enterprise. If, for instance, shad put into the White river should return in considerable numbers after three years, a single shad dinner would convert every member of the Indiana Legislature into a fish breeder,

and any reasonable appropriation could be secured to plant all rivers in that State. These first essays of the general government are to be regarded as tentative, and preparing the way for the completed work in which every State will have a share. Fish breeders may have no doubt of eventual success in planting shad in the upper waters of the Mississippi valley, but the people have no such firm faith and must see to believe.

The rapid spread of shad from the Alabama, where they were planted in small numbers in 1848, both eastward into the Escambia and its tributaries and westward into the Mississippi and into the tributaries of the Red and Arkansas rivers, is conclusive evidence that the fish have taken kindly to these muddy waters and will eventually populate them. Shad were first taken at the falls of the Wicheta, near Hot Springs, Ark., in 1860, only nine years after they were first captured in the Alabama. They are now caught by the cart-load, and for five weeks in spring furnish the main supply of animal food in the village market.

It is not improbable that many other streams nearer the gulf are already stocked with shad by natural methods, and that they have not been captured because there are no falls to obstruct their passage and no fishermen to drop lines for them. But even if the spread of this fish is going forward securely by natural methods, the people do not want to wait fifty years for an event which may just as well come in five years by artificial means. We want the fishes as well as the loaves in the great valley, at the earliest day and at any reasonable cost.

Something has also been done to increase the supply of white-fish in the great lakes. The destruction of this fish has gone on so rapidly that it has almost disappeared from many lakes where it was once abundant. Prof. Baird has about three-fourths of a million of eggs, in charge of Mr. N. W. Clarke, at Clarkston, Mich. It is proposed to send a large per cent of these to the fish commissioners of California, for the purpose of introducing them into Pacific rivers, and to take measures, another year, to multiply them largely in the great lakes.

The introduction of the Rhine salmon to our waters is another noteworthy event. Prof. Baird found a ready response to his inquiries for the spawn of this fish. He was promptly informed that, desirous of showing their appreciation of the American people, the German government would present the United States with 250,000.

He ordered an additional half million from Fryeburg, and engaged the services of Mr. Rudolph Hessel, an experienced fish culturist of Germany, to accompany them to this country. These eggs arrived at New York, February 4th, much injured by the warm weather at the time of their packing and during the voyage. Enough, doubtless, will be saved to try the experiment of raising them in our waters. They are supposed to be the same species as those found in our eastern rivers. The success in this importation has been so limited that it will have a tendency to discourage future drafts upon Europe for salmon eggs, especially when we have learned how to secure them on the Penobscot in the greatest abundance and at very moderate expense.

This enterprise, begun under the direction of Mr. Atkins, in 1871, with very limited returns, has been crowned with large success the present season. Prof. Baird was able to put $3,000 at the disposal of Mr. Atkins, yearly doubling the funds raised by the association.

A million and a half of eggs were taken and are now being distributed, principally among State Fish Commissioners who started the enterprise. A substantial hatching-house has been built near Bucksport, in the center of the salmon fisheries upon the Penobscot, so that it is easy to procure breeding salmon during the summer, and to keep them in ponds until the spawing season in November.

This method of taking eggs is original upon this side of the Atlantic, and promises to give us an unlimited supply of spawn at very cheap rates.

Nearly all of the eggs are impregnated, and the loss by transportation from Bucksport to the neighboring States is very small. About 200,000 of these eggs were taken to the hatching-house of the Poquonnoc Fish Co., and, after a two days' passage, the loss was less than six per cent, and this loss was mainly confined to unimpregnated eggs. It was exceedingly rare to find a dead egg with a fish in it. The management of salmon during the summer is now well understood, and the manipulation of the fish and impregnation of the eggs are about as certain as other kinds of business. It is mainly a question of money as to how many salmon spawn shall be taken in the Penobscot, under the management of Mr. Atkins. With this source of supply so near and so certain in its results, it will hardly pay to run the risks incident to a thirty days' voyage to secure the same kind of spawn in future years.

The discovery of a new species of salmon upon the Pacific coast

is an event, the significance of which we shall better comprehend a few years hence, when the fish shall have found a congenial home in all of our southern waters. Though this fish has been known to commerce ever since California was settled, it was not known whether it was the same species as our eastern salmon, or something different. There can be very little doubt but that it is a distinct species, quite as valuable for food as the "salar," and with some peculiarities adapting it to our southern and western waters.

Mr. Livingston Stone, secretary of the association, who had had some experience in taking salmon spawn on the Miramichi river in New Brunswick, was sent to the Pacific coast to secure salmon eggs of the Sacramento variety. Mr. Stone supposed, as did also the California Fish Commissioners, that their salmon spawned late in October, but to be in ample time he went to McCloud river, one of the feeders of the Sacramento, early in September, and immediately made the usual preparations to take spawn. The fish were abundant, but to his surprise he found that the spawning season was almost past, and he was unable to obtain more than 20,000 or 30,000 eggs. These were shipped eastward, and are now at the hatching-house of Dr. J. H. Slack, in New Jersey. Many of them hatched out on the way, and those that survived are destined to the Susquehanna river. The eggs are nearly twice the size of "salmo-salar." This fact, and the earlier spawning season, and the premature hatching of the eggs, are pretty clear indications of a different species.

Prof. Baird says: "The importance of this experiment with Sacramento fish may be understood from the fact that their breeding grounds on the river are in a region of very high summer temperature, reaching at noon from 100 degrees to 110 degrees Fahrenheit, for a considerable distance. Therefore, while eastern salmon are not likely to thrive west of the Connecticut, or at most of the Hudson, there is every reason to believe that the Sacramento fish can be introduced into nearly if not quite all of our rivers on the Atlantic coast; and we have every confidence that the time is not far distant when we shall have in the Delaware, the Susquehanna, the Potomac and the James an ample supply of these delicious fish, as well as in more nothern and eastern waters."

Another marked event of the year, and one that ought to have been much earlier known, is the introduction of Mr. Brackett's trays, as a substitute for Costie's boxes and all other contrivances for hatching eggs, and keeping them clean while incubating. Nothing, we

think, but the extreme modesty of that gentleman can account for the fact that he has kept so useful an invention to himself for four years, without patent or herald to proclaim its excellence. It is a simple frame made of inch stuff, about eighteen inches square, and lined with a wire cloth bottom of eight meshes to the inch. It just fits into the ordinary hatching trough, and is kept up a half inch from the bottom by a nail at each corner. This tray is coated with paraffine varnish, which makes it proof against all fungus growth. It is very cheap, very simple and the best thing we have ever tried for hatching eggs. One of these trays will hold two or three thousand eggs. They do not get dirty nearly so soon as when resting upon gravel, and, when it is necessary to clean them, the tray is lifted from its place, put under a fine hose and effectually cleaned in a minute or two. The saving of labor is immense. Then it is one of the most convenient vessels yet discovered for packing eggs in moss for transportation. At least 2,000 can be packed in one of them, and twenty-four of the trays can go in one box, very convenient for handling. A large number of the eggs moved from Maine to the hatching-house at Poquonnoc, Ct., came in these trays, and bore transportation quite as well as those coming in smaller packages. These trays are used at Bucksport, Me., by Mr. Atkins, and at Poquonnoc, and have given great satisfaction. They will unquestionably banish gravel from all well appointed hatching-houses, and supersede Costie's boxes and other glass grilles and charcoal boxes for preventing fungus. It cannot fail to largely increase the profits of the fish breeder.

On the whole, we have great occasion for congratulation as we review the substantial progress made during the year 1872.

Quite a large number of gentlemen have joined the association, whom we are happy to welcome to our deliberations to-day.

NATURAL vs. ARTIFICIAL SPAWNING AS PRACTICED IN THE CULTURE OF BROOK TROUT.

By FRED MATHER.

Mr. President and Gentlemen of the American Fish Culturists' Association.—Knowing as I do that most if not all of the members of this association practice taking the spawn of trout and other fish by hand, because they find it most convenient and profitable, it is not my intention to offer *them* any advice on a subject which is so

familiar to them; but as the discussions and proceedings of this body of earnest laborers in the comparatively new field of pisciculture are published far and wide, for the information of those who look to it as the fountain-head of knowlege on the subject, I would like to give the results of my own experience and observations, that have extended through a period of nearly five years.

I do not care to enter into a discussion as to the comparative health or constitution of fish from eggs taken in either way, although it is well known that I believe that the eggs laid in the natural manner will produce the hardiest fish, contrary to the opinion of some of our most distinguished trout breeders; but as I have so many letters from beginners who have failed in *both* ways of taking spawn, I find that there are more difficulties to be encountered by the novice than have ever been published.

The most general complaint is, that it is too much trouble to take the eggs of a few fish by hand; that from a pond containing but a few hundred fish, there are but very few spawners ripe at a time, and the operator goes to the raceway and bags all the fish in it many mornings for nothing, and his attendance is required every morning, no matter how stormy it may be, and Sundays as well as week days, for our trout have not yet been educated up to the point of religious observances.

On the contrary, the one who uses the Ainsworth screens can wait a more favorable time, if the day be cold or stormy, as a delay of a day or two will make no difference, and there is usually a time in each week when the weather is mild enough for the purpose.

The following is the record, for part of the season, of one of my ponds, which contains 300 four-year old fish:

1872.		
Nov. 13	1,500	spawn
Nov. 21, eight days after	5,000	"
Dec. 2, eleven days after	2,500	"
Dec. 12, ten days after	8,000	"
Dec. 20, eight days after	6,000	"
Dec. 28, eight days after	1,500	"
1873.		
Jan. 8, eleven days after	6,500	"
Jan. 17, nine days after	2,000	"
Jan. 25, eight days after	11,500	"

This is as far as the record goes this year, but they will probably extend the spawning season into March, as they did last year.

It will be seen that on the 28th of December, after an interval of eight days, there were only 1,500 spawn deposited, probably two fish in the whole week, and this right in the height of the season.

The beginner also kills more or less fish, generally *more*, as there is some loss from handling, even by an experienced operator, therefore he should always use the screens, for a while at least.

The only complaint I hear against the screens is, that the per centage of impregnation is not so great as by the hand system; this comes mostly from those who are engaged in supplying the spawn to those just starting in business.

This objection is of small value to persons who wish to take it for their own use, as the comfort and convenience of the screens will far outweigh any consideration of that character.

I have received letters of inquiry by the score, concerning the details of the management of the screens, in the past two years; two of them were from experienced hand operators, saying that the per centage of impregnation was very low on their screens, and asking advice; and my answer has been, that at my ponds at Honeoye Falls, N. Y., I use large gravel, from the size of a black walnut to a hen's egg, and but *little of it;* hardly a water pail full to a box three feet long by two feet wide.

I often find all the gravel swept into one end of the box, and have known the fish to spawn on the bare painted wire and sweep the gravel over it, leaving the other end bare. Of course, the only reason that more eggs are not impregnated is because the milt fails to reach them, through becoming too much diluted; and to lessen the chance of this, I have the distance between the upper and lower screen as small as possible; in some cases they have actually touched, from the sagging of the upper screen with its weight of gravel. These are the main points, and by observing them more closely my per centage of fertilized eggs has increased two and a half per cent this season over the average of last year.

This per centage has varied from eighty and a fourth to ninety-two, the average for the part of the season ending at the present writing (January 28th, 1873) being eighty-seven and a half.

By the dry method nearly 100 per cent of all eggs taken can be fecundated, which is considered a great saving; but are all the eggs taken? Experience has shown that trout often disturbed on the beds

will seek another spot, and will sometimes spawn in the middle of the pond on a bare stone, in preference to the graveled raceway; and may it not often occur that some fish who have a nest in the raceway may be in the pond when the haul is made, and will return and deposit their spawn after the operators have left? And here the question arises, will not the number of eggs lost by both these causes nearly if not quite counterbalance the loss of unimpregnated eggs taken on the screens?

Honeoye Falls, N. Y.

ON THE IMPREGNATION OF TROUT EGGS.

By J. R. Dykeman.

It will be impossible for me to attend the meeting of your association, as I am attending to the details of the hatching-house myself this winter, and my first fish are about at the first feeding stage. In the printed report, and in all statements published, it has appeared to me that figures were something all trout culturists were afraid of. I will give you some of this season's, up to and including yesterday, promising that as far as they go they are as accurate as careful counting (not measuring) can make them. My hatching boxes are arranged on each side of a distributing box in center of house (boxes four and five feet long and fourteen inches wide), in triplets, with passages between, so that I have a complete way of keeping any lot of 5,000 to 10,000, without danger of intermixing.

Section No. 1.—Eggs taken from pond No. 3 on Collins' screens, from November 9th to 28th, 1872. Fish mostly from streams in neighborhood, about one pound in weight on an average. Total number of eggs, 4,559. Unimpregnated, 1,038, or seventy-eight per cent good. Commenced to hatch December 25th. Total loss of fish up to 9th inst., 1,231, being twenty-eight per cent of total eggs, or thirty-five per cent of the impregnated.

Number of fish died first week after hatching	136
Number of fish died second week after hatching	639
Number of fish died third week after hatching	199
Number of fish died fourth week after hatching	114
Number of fish died fifth week after hatching	88
Number of fish died sixth week after hatching	55

Section No. 2.—Eggs taken November 25th and 27th, Ainsworth & Collins. Eggs from pond No. 3, and some from pond No. 1. My own raising of fish, nearly two years old. Total number of eggs taken, 5,254, or sixty-eight per cent impregnated. Unimpregnated, 1,692. Commenced to hatch December 31st.

Number of fish died first week after commencing to hatch..... 129
Number of fish died second week after commencing to hatch... 407
Number of fish died third week after commencing to hatch. .. 330
Number of fish died fourth week after commencing to hatch... 58
Number of fish died fifth week after commencing to hatch..... 12

Loss of fish to date 1,036, being twenty per cent of whole number, or twenty-nine per cent of the impregnated.

Sections Nos. 3 and 4.—Eggs taken artificially in small quantity of water from fish out of pond No. 3, November 25th and 27th. Total number of eggs taken 11,523, or forty per cent. Eggs unimpregnated 4,666.

Number of fish died first week after commencing to hatch..... 43
Number of fish died second week after commencing to hatch... 194
Number of fish died third week after commencing to hatch.... 472
Number of fish died fourth week after commencing to hatch.... 188
Number of fish died fifth week after commencing to hatch..... 99

Total loss of hatched fish to date 996, or nine per cent of total number of eggs, or about fifteen per cent of impregnated.

The above are all that are far enough advanced to tell the probable loss up to time of commencing to feed. I think the above shows the loss to be principally of weak fish. There were some deformities which were taken out and counted with the dead.

Temperature of water forty-eight and forty-nine. Some fungus grew on the wood work of the grills. My boxes are all charred, but according to Slack "doing no possible harm." (See page ninety-one of his book.)

I give below the figures of all that are hatched up to date.

Spawn from pond No. 3. Old fish taken on Collins' roller screen. Total number 21,904, or fifty-eight per cent impregnated. Unimpregnated 9,303.

Spawn from young fish of our own raising. Pond No. 1 mixed with pond No. 3. Collins' screen. Total number 17,641, or sixty-eight per cent impregnated. Unimpregnated 5,725.

Spawn from own rearing of fish nearly two years old, in pond No. 1. Ainsworth screens. Total number 4,450, or fifty-one per cent impregnated. Unimpregnated 2,142.

Artificial, taken in small quantities of water, and about one-half taken dry. The detailed accounts do not make hardly any difference between the two ways of taking; if anything, it is in favor of small quantity of water. Total number 35,243, or fifty per cent of impregnated. Unimpregnated 17,480.

My fish are not done spawning yet; will get about 6,000 yet. Have put in total number 120,609 of my own; from F. Mather 1,917. Total, 122,526.

The flow of my spring is 2,500 gallons per minute. It never freezes inside my hatching-house, which is well built of stone.

Shippensburg, Cumberland county, Penn.

ON THE FECUNDATION OF FISH.

By Charles Bell.

I have been for some years past considerably interested in the artificial propagation of fish, and I have read every publication on the subject that I have had access to, especially those regarding either the theory or the practice of artificial impregnation. And, in so doing, I have hit upon one point upon which the writers on pisciculture agree with each other, but do not agree with the best authorities upon physiology, that is, the "spermatozoa," or the fecundating principle of the seminal fluid of the male fish, and it is to this point that I would like to call the attention of the association, as I believe it to be of vital importance that we should understand the true nature of the "zoösperm." I find that the general impression among writers on pisciculture is, that they are living animal organisms, while physiologists concur in the opinion that they are simply filaments of albuminoid substance. With your permission I will quote to you from that admirable little work by Mr. Livingstone Stone, entitled "Domesticated Trout," and from Mr. Fred Mather's articles in the "Farm and Fireside Journal;" both of these gentlemen are practical fish culturists, and undoubted authority upon the subject I will also quote from J. P. Dalton, Jr., M. D., Professor of Physiology and Microscopic Anatomy in the College of Physicians and Surgeons, New York.

1st. From Mr. Stone, viz.: "For the benefit of those to whom this part of the subject is unfamiliar, I will say that the milt or seminal fluid of the male fish consists [or contains, I have forgotten the exact language in that case] of innumerable *living microscopic* organisms, called spermatozoa or zoösperms; these millions of infinitesimal creatures, during their brief career in the outer world, are endowed with great activity, and jump and plunge about among one another with a motion as ceaseless as it is rapid and vigorous."

From this you will see that Mr. Stone believes them to be living animals, but Dr. Dalton does not agree with him in that respect, although Mr. Mather does. I will next quote from Mr. Mather's article in the December number of the "Farm and Fireside Journal;" he says: "As before stated, the egg will absorb milt or water for about half an hour, and is, of course, open for impregnation nearly that length of time; but the *animalculæ* of the milt, though they will live in their own fluid we know not how long, will die in a few minutes in cold water."

In this article Mr. Mather does not hesitate to call the spermatozoa animalculæ, a title that I do not think appropriate or correct; but as he and Mr. Stone together opprove of the term, I would not venture to correct them myself, but I will submit the evidence on both sides to the association, and they shall decide, not whether we shall call them "zoösperms" or "animalculæ," but whether they are living animals or simply shreds of albumen.

The following extract is from Dr. Dalton's "Treatise on Physiology," published in 1859, at Boston:

"The most remarkable peculiarity of the spermatozoa is their very singular and active movement, to which we have already alluded. If a drop of fresh seminal fluid be placed under the microscope, the numberless minute filaments of which it is composed are seen to be in a state of incessant and agitated motion; this movement of the spermatozoa, in many species of animals, strongly resembles that of the tadpole." * * * "The tail-like filament constantly keeps up a lateral and vibratory motion by which the spermatozoon is driven from place to place in the spermatic fluid, just as the fish or tadpole is propelled through the water. In other instances, as, for example, in the water lizard, the spermatozoa have a continuous writhing or spiral-like movement, which presents a very peculiar and elegant appearance when large numbers of them are viewed together; it is the existence of this movement that first suggested the name of spermatozoa, to

designate the animated filaments of the spermatic fluid, and which has led some writers to attribute to them an independent animal nature. This is, however, a very erroneous mode of regarding them, since they cannot properly be considered as animals, notwithstanding the active character of their movement, and the striking resemblance which it sometimes presents to a voluntary act. The spermatozoa are organic, which are produced in the testicles and constitute a part of their tissue, just as the eggs which are produced in the ovaries naturally form a part of the texture of these organs; like the egg, also, the spermatozoon is destined to be discharged from the organ where it grew, and to retain for a certain length of time its vital properties. One of the most peculiar of its properties is its power of keeping in constant motion, which does not, however, mark it as a distinct animal, but only distinguishes it as a peculiar structure belonging to a parent organism. The motion of a spermatozoon is precisely analogous to that of a ciliated epithelium cell. The movement of the latter will continue for some hours after it has been separated from its mucous membrane, provided its texture be not injured nor the process of decomposition allowed to commence. In the same manner the movement of the spermatozoon is a characteristic properly belonging to them, which continues for a certain time, even after they have been separated from all connection with the body."

This, you see, is a direct refutation of the "living organism" theory, and I would very much like to have the opinion of the association upon the subject.

Honeoye Falls, N. Y.

FISH CULTURE ABROAD.

By George Shepard Page.

You are all doubtless familiar with the fact that for many centuries that wonderfully ingenious people, with whom we are becoming somewhat familiar in these times of dear labor, the Chinese, have extensively pursued the science of fish culture, indeed making it one of the chief industries of several of the principal provinces. They economize the immense rice-fields at the season when they are covered with water, thus obtaining a double harvest. The species of fish cultivated are probably the carp, as the eggs are deposited on

fagots placed in the water, and these spawn-covered fagots are sold in the markets as with us are hens' eggs. Rice and fish form the principal food of the Chinese. They are very cheap, hence "Chinese cheap labor." Success with us in this industry will do much to solve one of the most difficult and dangerous problems of the day, the labor question.

The Romans seem to have understood and extensively practiced fish culture. They prepared large ponds, opening by canals to the sea, through which fish passed seeking the fresh water spawning grounds. The parent fish were prevented from returning by flood-gates, which barred their progress to the sea, and while their progeny were growing they supplied the market. The celebrated salmon-breeding establishments in Norway, Scotland and Ireland, seemed to have followed much the same plan. From the time of ancient Rome we learn nothing of fish culture for several centuries. A little more than a hundred years ago, a young German naturalist, ardently devoted to the study of nature, was one day lying upon the bank of a rippling brook, watching a number of fish engaged in spawning. In pairs they had carefully removed the sediment from the gravelly bottom, and by pressure of the abdomen upon the pebbles he saw the eggs deposited by the females, quickly followed by the milt deposit of the male fish. Thought he, why cannot I press the eggs and the milt from the fish and hatch them in the little stream near my cottage? He did it, and the name of Jacobi will live and be honored among the great benefactors of the human race. It is but fair to state, however, that the honor of first discovering the art of artificial impregnation is claimed by several writers for the Monk Dom Pinchon, of Rouen, France, in the fourteenth century. Yet the science was not pursued practically to any extent, and the rivers and lakes of Europe were, by the early part of the present century, nearly depopulated of food fishes by the same causes that have so thoroughly depleted our own—the erection of impassable dams, the refuse of manufactories, and indiscriminate fishing.

By the year 1849 the question of cheap fish food for the masses became of such importance that the French government invested a large sum of money in the erection of the first piscicultural establishment at Huningue; and the grand results of their enlightened policy have been felt all over Europe and in our own land. The following graphic description, by a distinguished English writer, of the place where practical fish culture was first instituted, will be of interest:

"The series of buildings at Huningue are admirably adapted to the purpose for which they were designed. The group forms a square, the entrance portion of which—two lodges—is devoted to the corps de garde, and the center has been laid out as a kind of shrubbery, and is relieved with two little ponds containing fish. The whole establishment, ponds and buildings, occupies a space of eighty acres. The suites of buildings comprise, at the sides, two great hatching galleries, sixty metres in length and nine metres broad, containing a plentiful supply of tanks and egg-boxes; and in the back of the square are the library, the laboratory and the residence of the officers. The egg-boxes are raised in pyramids, the water flowing from one on top into those immediately below. The water supply is derived from the springs on the grounds, the Rhine, and the Augrabea streams. The water of the higher springs is directed toward the building through an underground conduit, while those rising at a lower level are used only in small basins and trenches for the experiments in raising fish outside. As a general rule, fish are not bred at Huningue, the chief business accomplished there being the collection and distribution of their eggs; but there is a large supply of tanks and troughs for the purpose of experimenting with such fish as may be kept in the place. The waters of the Rhine, being at a higher level than the springs, can be employed in the basins. Of course, different qualities of water are quite necessary for the success of experiments in acclimatization carried on so zealously at this establishment. Some fish delight in a clear running stream, while others prefer to pass their life in sluggish waters.

"The course of business at Huningue is as follows: The eggs are brought chiefly from Switzerland and Germany, and embrace those of the various kinds of trout, the Danube and Rhine salmon, and the tender ombre Chevalier (a large char). People are appointed to catch gravid fish of these various kinds, and, having done so, to communicate with the authorities at Huningue, who at once send an expert to deprive the fishes of their spawn and bring it to the breeding or store boxes, where it is carefully tended and daily watched till it is ready to be dispatched to some district in want of it."

Up to the season of 1863–64 the total number of fresh water fish-eggs distributed from Huningue was far above 110,000,000, and nearly half of these were of the finer kinds of fish, there being no less than 41,000,000 of the eggs of salmon and trout. This great establishment passed into the possession of the Germans by the

cession of the Provinces of Alsace and Lorraine, and is now conducted on a still grander scale under the auspices of the Deutscher Fischerei Verein. This society is the "Fish Culturists' Association" of the North German Confederation, and among its most active members are Count Bismark, the Grand Duke, "our Fritz," Count Munster (a Minister of the Empire), Geo. von Bunsen, Esleben and other members of the Parliament, and Prof. Peters, of the University of Berlin. Through this agency hundreds of rivers, lakes and ponds in Europe are now once more teeming with the most valued species of the finny tribe. Many private piscicultural establishments are now in active operation in various parts of Europe. Probably many of my hearers have visited that interesting feature of romantic Heidelberg—the trout ponds. Norway and Sweden are making rapid strides in practical fish culture. One of the most important—indeed, I may say the most important discovery—in the art, comes to us recently from the Governmental Fish-hatching Establishment of Russia, the system of dry impregnation. Previously the eggs and milt were extruded in a pan of water, and but a comparatively small per centage hatched. By the Russian plan the eggs are first pressed from the fish into an empty dish, and the milt dropped directly on the eggs. Livingston Stone reported at our last annual meeting that he had hatched ninety-nine out of one hundred eggs by this process.

But I must pass rapidly from this continent to England, Scotland and Ireland, in order that we may learn the wonderful success experienced in bountifully restocking depleted and exhausted rivers with the king of the finny tribes, salmo-salar. Twenty-five years ago the salmon had been nearly exterminated in most of the rivers of the United Kingdom, and only the wealthiest could indulge in the great luxury. One of the most noted salmon rivers was the Tay. You are well aware that the fishing privileges of Great Britain are nearly all private property, and are leased by their owners, either at so much for the entire river, or a license is granted to a single fisherman with rod or net, for sport or for the market. The lessee of the Tay, alarmed by the regular diminution in the number of salmon taken, constructed extensive hatching works at Stormontfield. The salmon captured in nets, if ripe, were manipulated and the eggs placed in the hatching boxes. If the salmon were not ready to spawn, they were liberated in an adjacent pond and retained till the proper time. The eggs require about 130 days to hatch. The young fry remain in the compartments six weeks, and then run into a small

pond. They are fed on boiled and grated liver. After the first year they are turned into another pond in order that the first pond may be occupied by the new crop of fry. A third pond is used to receive the half of the brood becoming smelts the second year. Three hundred and fifty thousand eggs are hatched at this establishment annually; and as a female salmon will yield about 1,000 eggs for every pound she weighs, you will readily see that a small number are required to supply the boxes, say twenty-two of fifteen pounds each. It is stated that ninety per cent are hatched. Now let us examine the practical results: The catch of salmon, and hence the rental of the stream, regularly increased. In 1853 the rental was £8,700, $43,500; 1854, £9,200; 1855, £9,900; 1858, £11,400; 1860, £13,000; 1862, £14,000; 1864, £15,000, $75,000. The river Tay is not much, if any, larger than the Passaic in New Jersey, or the Thames in Connecticut. The operations at Stormontfield attracted the attention of others interested, and the same plan was pursued by Ashworth in Ireland, on the Galway; Cooper on the Owenmore and Arrow and Ballysadare; Martin and Gillon on the Dee, and many other rivers in England, Scotland and Ireland have been densely repopulated with salmon.

The following extract from an account published in the London Field, of the success of artificial hatching, and the return of the salmon by the way of the salmon ladders erected by Mr. Cooper over the previously impassable falls of the Ballysadare, will be heard with the deepest interest, especially by those who have not, like our enthusiastic veteran angler friend, Thad. Norris, Esq., visited the far-off salmon rivers of Canada and Labrador, or been permitted to witness the remarkable catch of Charles G. Atkins, Esq., last summer, at the mouth of the Penobscot, sixteen salmon, in six weeks, taken un-a-wares (in a weirs) with a fly-net: August 24, saw several salmon in the hole under the fall of Collooney. September 24, the river between Ballysadare and Collooney is now well stocked, salmon being visible in almost every deep hole, and a number being congregrated between Collooney bridge and the hole under the fall. October 3, seven salmon and one white trout in the pond. October 13 counted twenty-seven salmon, mostly females, in the Collooney ladder. October 28, three male fish in the ladder; 30th, four male and two female fish in the ladder. November 3, sixteen male and eight female; 4th, ten fish in the ladder; 5th, nine fish; 6th, seven ditto; 7th, eleven ditto, and saw several large fish leaping at the ladder at

Ballysadare; 9th, twenty-four male and fifteen female fish in the ladder; 23d, twenty-five male and twenty female fish, ditto, some very large; December 3, thirty male and forty-five female salmon found in the ladder. The regular fishing season began in July, when we caught 868 salmon, and up to the 20th of August 530 more—in all, 1,398. The following year (1858), the number increased wonderfully. August 28, at Ballysadare, numbers of salmon in every part of the river; September 1, Collooney ladder literally full of fish; September 25, Collooney ladder swarming; October 3 to 6, heavy floods; the ladder resembles a steeple chase, as we see them clearing the steps in pairs; November 27, great numbers of fish in the ladder. One of my men counted 207 salmon in one hour ascending the ladder, and Mr. Calbertson has written me saying he reckoned 100 in less than half an hour making up the rapids at Ballysadare. On yesterday, December 2, there was so many fish in the pond at Collooney, that Mr. Leech took up no less than six at once, in a landing net. December 19, counted nineteen at upper step of ladder in five minutes, turned off the water and put up 256 salmon; 11th, counted 102 fish jump at the upper step in five minutes; turned off the water; the pond actually alive with fish, in general larger and fresher from the sea than those of yesterday; put up 246 fish and then stopped, as the fish were getting sick in the pond. I am confident we left 300 to 400 in the pond. And now, supposing that you can still endure a few more such delightful figures, telling us so forcibly that what has been done on these small streams in old Ireland, and Scotland and England, can be done on a far greater scale in our magnificent river. Let me worthily conclude them by the following report of Mr. Ainsworth, detailing the catch of salmon before and after the commencement of his enterprise on the Galway: 1853, number taken, 1,603; 1855, 5,540; 1858, 9,639; 1861, 11,051; 1862, 15,431; 1863, 17,995; 1864, 20,512; and since then the numbers have still increased. In 1866 over 1,000 tons of salmon were shipped by the railroads of Ireland. Salmon can be purchased in London at twelve cents and fifteen cents per pound.

And now, fellow-members of the American Fish Culturists' Association, if such wonderful results as these can be obtained abroad, what may we not anticipate in the early future for our beloved America. Let us labor on until by our exertions we so multiply the salmon, the trout, the shad, the black bass, that whosoever will, be he rich or poor, may abundantly partake.

FISH CULTURE IN JAPAN AND CHINA.

United States Consulate,
Kanagawa, *September* 5, 1872.

Hon. Charles Hale,

Assistant Secretary of State, Washington:

Sir.—Referring to your dispatch No. 60, I have the honor to report, that from the best information within my reach I glean the following facts:

In Japan there is no scientific or business method of propagating fish. The great abundance of salt-water fish and the fact of but little being used which is not previously salted does not seem yet to involve the necessity of propagation. A few daimios, chiefly in the south and also in Kuishiu, have transferred live fish when young (not two inches long) from river to river, from river to pond, and from pond back to river again. They are transferred in small flat vessels of water and put into temporary artificial ponds made of puddled clay, only a few inches deep, and covered with netting to keep the fish safe from attack of birds. The gold-fish are treated in this way, as are also a kind of fish called koi, which resemble somewhat carp, but are rounder. They are fed on very small worms, dug out of mud at the bottom of stagnant or slow-running ditches. At the end of three weeks or so the pond is made to communicate by a channel either with a larger pond of old standing, or a river, and the artificial pond is thus emptied of its stock. This is done in Hizen and Bingo for ornament of gardens.

Salmon abound in the rivers on the western coast of Nipon, north of this latitude, as do also black bass. Terso and its rivers teem with salmon, the fishing for which by net on the sea-shore begins about the 1st of September and ends about 27th of November. Fishing for salmon by net is at present going on about eighty-five degrees north-east from this port on the Pacific coast.

I have the honor, sir, to be
Your obedient servant,

C. O. SHEPARD,
Consul.

UNITED STATES CONSULATE-GENERAL,
SHANGHAI, NOVEMBER 9, 1872.

Hon. Charles Hale, Assistant Secretary of State, Washington:

SIR.—In response to instruction No. 315, which I have the honor to receive in duplicate, I have to say that the practice of the rearing of fish in China by artificial means is said to have obtained to some extent. Natives and some foreigners long resident in this country agree that the art is, or has been, practiced in certain inland districts, but as to how, when or in respect of the process, I am yet unable to get real information.

My own observation from traveling in the interior of this province, where water communication is second to no other part of China, is, that the practices of the natives are adverse to successful culture of fish—because they catch at all seasons, even digging in muddy creek-beds to obtain the fish, and in spawning season take advantage of the resort of the female to fill their nets.

I have addressed myself to various sources, native and otherwise, to learn, if possible, some details, and upon the receipt of such I will address the Department accordingly.

I am, sir, your obedient servant,

O. B. BRADFORD,
Vice Consul-General.

THE NATIVE FISH OF UTAH.

BY A. P. ROCKWOOD, SUPERINTENDENT OF THE FISH FARM IN SALT LAKE CITY, UTAH.

First, the lake trout, which is of a dark green shade on the back and upper part of the sides, gradually becoming lighter toward the belly, with black spots on the sides and upper part of the tail. The average or medium weight is about four pounds, though they have been caught weighing upward of twenty-five pounds.

Fishermen find full-grown eggs in this fish in February and June. They are found principally in or near the fresh-water lakes.

Second, brook trout, which are found usually in the mountain streams. They are of a steel color on the back, which run to silver on the belly, with dark red spots on the back and tail. The average weight is about one and one-fourth of a pound, increasing to two and one half. Full-grown eggs are usually found in June.

We have a fish here, called by the fishermen *mullet*, of the sucker family. This fish ranks next to the trout in quality; the color ranges from a deep red to a dark green, and is nearly as light on the belly as the trout. The usual weight is about one and one-half pounds, increasing to five pounds. Full-grown spawn is found in February and June. From the vent forward, few bones are found; behind the vent there are quite a number of small ones.

The sucker, the most inferior fish we have, is somewhat lighter than the mullet, and nearly the same shape and size, being very bony; some portions of the bones are bound in bunches by a circular bone.

The chub, of the perch family, is of a dark lead color on the back, and light silver on the belly; the average weight is about one pound, increasing to two pounds. These fish are about the same in quality as the Atlantic perch; they spawn about the same time as trout. The mountain herring, or silver sides, is of a bright silver color; has few bones, and is of good quality, but very scarce. Adults weigh from one-quarter to one-half of a pound.

Occasionally there is a small fish caught, that appears to be one of the cat-fish family; it weighs about two ounces. This fish is very scarce, and of inferior quality.

NATIONAL FISH CULTURE.

The following is the annual report of Hon. Spencer F. Baird, United States Commissioner of Fish and Fisheries, for the year 1872:

This report was printed early in the present year in another form, but it contains so much that is important and interesting on the subject of fish culture that no apology is needed for its insertion in connection with the papers of the association.

At a meeting of the Association of American Fish Culturists and of State Fish Commissioners, held in Albany in February, 1872, it was determined to make application to Congress for assistance in stocking the greater rivers and lakes of the United States with useful food fishes, on the ground that, whatever the several States might be willing to do for themselves respectively, they were not ready to enter upon any measures the benefit of which would inure partially, or perhaps exclusively, to the citizens of other States.

It was also believed that much remained to be done in the way of

introducing the best varieties of foreign fish, such as might be especially suitable for certain waters to which our domestic species are not so well adapted, thus acting on the same principle as that by which the Agricultural Department takes measures to procure new and desirable kinds of foreign seeds and plants, and disseminates them throughout the United States. A committee was elected to carry out the wishes of the association, and Congress finally made an appropriation of $15,000 for this purpose, the disbursal of which was placed in my charge as Commissioner of Fish and Fisheries. As the American Fish Culturists' Association had been so closely connected with the measures for obtaining the desired appropriation, I felt it my duty to ask their advice as to the initiatory steps to be taken in the enterprise, and at my request a special meeting was held in Boston in the beginning of June, at which the question was brought up as to the species of fish that should first be taken into consideration, and the measures most suitable for securing their multiplication. It was advised that shad, salmon and white-fish be the kinds first attended to, and, after a very full and free interchange of views, and receiving many valuable suggestions, I proceeded to Eastport, in Maine, which served as my head-quarters until October, both for the inquiry into the decrease of the food fishes of the United States, and the question of their multiplication. The appropriation was not made until early in June, and was not available until the 1st of July, and there was, consequently, little time for doing much during the year in respect to the introduction of shad. I was so fortunate, however, as to engage the services of Mr. Seth Green, of Rochester, and Mr. Wm. Clift, of Mystic Bridge, Conn., both experienced fish culturists. Mr. Green, by permission of the Fish Commissioners of New York, obtained a large number of young shad from the State establishment near Albany (some hundred thousand), and carrying them west, placed a portion in the Alleghany river, at Salamanca, and another portion in the upper Mississippi, at St. Paul. A much larger number would have been used but for the fact that the season on the Hudson lasted only a few days after it was possible to authorize Mr. Green to undertake the work. The season for hatching shad in the Connecticut river being rather later than in the Hudson, Mr. Clift was able to obtain a large supply, through the kindness of the Connecticut Commissioners, and accordingly proceeded with several millions to the west. Of these a portion were planted in the Alleghany river, and another portion in the White river, at Indiana-

polis, with a view of determining the practicability of transporting young shad over long distances in midsummer (a problem already experimented upon successfully by Mr. Seth Green, by taking young fish from the Hudson to the Sacramento). Mr. Clift started for the Rocky Mountains with the remainder of his fry, and, notwithstanding the intense heat, succeeded in reaching Denver with several thousand of living fish, which he placed in the head-waters of the Platte. We have much reason to anticipate success in the experiment of stocking the Mississippi river with shad, since we know that the Alabama river has been stocked by the efforts of Dr. Daniel, by carrying impregnated eggs from Savannah across to its head-waters; and there are instances, which are detailed fully in my report, of their occurring in considerable numbers at the hot springs of the Onachita; at Neosha Falls, Kansas; at the fall of the Ohio, at Louisville, and in the Wabash river.

There is little or nothing to interfere with the anticipation that, with proper efforts, shad may swarm in the waters of the Mississippi valley, including all the tributaries of the gulf, in the course of five or six years, in numbers corresponding to those in the Potomac, Delaware and other Atlantic coast streams generally. The experience of the State of Connecticut in this respect is a case in point. The supply of shad in the Connecticut for several years had been greatly diminished, as compared with its former usual abundance, owing to the reckless methods of fishing. A few years ago the Commissioner of Fisheries of Connecticut undertook the business of hatching out the shad, and has been turning out young fish, year by year, in increasing numbers, until the aggregate in 1871 amounted to about 50,000,000, and in 1872 to 91,000,000. The benefit of this action was satisfactorily exhibited in the spring of 1872. Immense schools of shad were met at sea, bound for the Connecticut river, and the number of fine, marketable fish actually taken in its vicinity was so great that they became a drug in the market, scarcely worth more than five or ten cents each. This condition of things was, of course, not very satisfactory to the fishermen nor the marketmen, who preferred larger profits with less trouble; but the boon to the people and consumers generally cannot be overestimated.

I desire to commence operations in regard to the shad at a very early period during the year 1873, by impregnating the spawn and hatching out the young in all the Atlantic rivers, beginning, perhaps, with the St. Johns of Florida, and proceeding, with the advancing

season, to the streams further and further north, until the work can be closed on the Connecticut river. The young fish can be taken from the coast, by the lateral lines of railroad, to different points in the west and introduced in hundreds of localities; and it is hoped that many millions of young fish may thus be started on their own way, to become the progenitors of an ultimate supply in the waters of the entire Mississippi valley. If authority be granted, similar efforts with regard to shad will be made on the great lakes, in continuation of the labors of the Commissioners of New York and Vermont, by whom several thousands of young fish have been planted in the tributaries of Lake Champlain and Lake Ontario. The practicability of having shad in abundance in the great lakes, cut off from access to the sea, is yet to be proved; but an augury of success is drawn from the fact that, by reason of discoveries made very recently, partly in connection with the United States Commission of Fisheries, the waters in the deeper portions of these lakes have been found to abound with minute crustaceans which are very similar if not identical with those which form the chief sustenance of the shad and also of the salmon in the ocean.

As regards the salmon, time was available to act with more deliberation, so as to secure more definite results, the spawning season for the eastern fish, as is well known, being as late as the end of October or the beginning of November. The fact that nearly all the rivers of the United States, which formerly abounded with salmon, are now destitute of them, made it necessary, of course, to adopt measures for obtaining spawn in large quantities. Heretofore the only establishment in America where these could be purchased was the hatching-house belonging to the Canadian government, at Newcastle, in Ontario, not far from Toronto, and under the care of Mr. Wilmot. The price charged, however, of forty dollars (gold) per thousand, was almost prohibitory; and, at any rate, the number that could be obtained at any price was too small to be of much value in the proposed experiment. Accordingly, I adopted three methods for procuring the desired supply, in which I was encouraged by the fish culturists at their meeting already referred to. It is known to most persons that salmon come from the sea in the early spring, and, entering the large rivers, pass high up to their head-waters, remaining there for several months before the business of spawning is begun. Fat and in good condition at first, they gradually become very poor and emaciated, until in the breeding season they are unfit for food.

After the eggs are deposited, the salmon return to the sea, or in some instances proceed into the large lakes, and there recuperate for future operations. Taking advantage of this habit of the fish, Mr. Charles G. Atkins, the former Fish Commissioner of the State of Maine, undertook, in 1871, the then untried experiment of securing the salmon on their first entrance into the river, and penning them up until the spawning season in the fall. The living fish were purchased from the fishermen, and after remaining in the inclosure until the proper season, the operation of taking their spawn was entered upon. His success in 1871 induced me to join with the commissioners of several of the States in giving to Mr. Atkins the means of carrying on the work on a much larger scale, and this was prosecuted with such vigor that as many as 600 sound, healthy salmon were secured. The subsequent operations were successfully conducted, and, as the result, Mr. Atkins now has in his hatching-house at Bucksport, Me., on the Penobscot, about a million and a half of salmon eggs, which, at the prices charged by the Canadian government, would be worth $60,000 in gold; the actual cost, however, being something less than $8,000 in currency. Half of these eggs are the property of the United States. The European salmon and that of eastern North America are believed to belong to the same species, and the same variety from the Rhine is considered as pre-eminent for the excellence of its fish, and for the sport it affords to the fishermen. Knowing that the German government was carrying on the fish establishments at Hüningen (first started by the French, but subsequently, by the fortune of the late war, falling, with the province in which it is situated, into the possession of their rival), I applied to some friends connected with the German Fisherei-Verein to know upon what terms I could obtain a large number of eggs. I was promptly informed that, desirous of showing their appreciation of the American people, the German government would present the United States 250,000 eggs, and that these would be ready at the proper season for transmission. Very grateful for this unexpected act of liberality, I ordered an additional half million of eggs from the private establishment of Oberburgomeister Schuster, at Freiberg, and engaged the services of Mr. Rudolph Hessel, an experienced fish culturist of Germany, to accompany all these eggs to America, so as to be assured of the best attention for them on the voyage. These will probably leave Bremen about the 11th of the present month, and be here before its close. The magnitude of this transaction may be understood from the fact

that the weight of eggs in their packings will not be less than 7,500 pounds.* Desirous of having a still larger number available for the experiment with the salmon, I engaged the services of Mr. Livingston Stone, a well known fish culturist, of New Hampshire, and directed him to proceed to California with a view of securing eggs of the Sacramento species, which is different from that of the Atlantic coast, but in its season not inferior in eatable qualities. Although it was thought the spawning season of the Sacramento salmon was about the same as that of eastern fish, namely, toward the end of October, Mr. Stone lost no time in proceeding to the west coast, where he placed himself in communication with the California Fish Commissioners, and, partly by their advice, selected a locality on the McCloud river, a tributary of the upper Sacramento, where he established his hatching-house, and then proceeded to seine the fish which were there in great abundance. To his surprise and disappointment he found that the spawning season in the McCloud river was actually in the early part of September, and he was consequently unable to obtain more than 20,000 or 30,000 eggs. These were shipped eastward, and the greater part of them are now in a thriving condition at the establishment of Dr. J. H. Slack, at Bloomsburg, N. J., in preparation for their transfer to the Susquehanna river. The importance of the experiment with the Sacramento fish may be understood from the fact that their breeding grounds on that river are in a region of very high summer temperature, reaching at noon from 100° to 110° Fahrenheit for a considerable distance. Therefore, while the eastern salmon is hardly likely to thrive west of the Connecticut river, or, at most, of the Hudson, there is every reason to believe that the Sacramento fish can be introduced into nearly if not quite all the rivers of our Atlantic coast; and we have every confidence that the time is not far distant when we shall have in the Delaware, the Susquehanna, the Potomac and the James, an ample supply of these delicious fish, and northern waters as well as in more eastern.

I propose to place a large portion of the Penobscot and German salmon eggs in the tributaries of the great lakes, as the fact of the occurrence of the natural food of the shad in our lakes, in ample quantity, applies equally well to the salmon. It is likewise my intention to try the experiment of introducing the salmon and the shad into the great Salt Lake of Utah. In this a body of salt water, according to Stansbury, of 291 miles in circumference, exclusive of

*None of these eggs survived.

offsets, and abounding in low forms of crustaceæ, and in dipterous larvæ to an unheard of extent, admirably fitted for feeding myriads of any fish that can live in it. That the purely fresh-water species of trout and cyprinidæ are unable to survive therein is not to be wondered at; but there seems no good reason to suppose that salmon, shad and alewives may not find a perfectly fitting resting place, and one where they would in time multiply to an extraordinary degree, in consequence of the entire absence of the predaceous fishes, such as sharks, blue fish, etc., which tend to keep down their numbers in the ocean. The experiment is worth trying, at any rate, and if successful it will add immeasurably to the food resources of the central portion of the west. In addition to the genuine salmon ordered from Germany, a large number of hybrids, between the salmon and the trout, are expected. It has been established recently in Europe that such crosses are not only fertile to a considerable degree, but that the fish lose their instinct of wandering to the sea and remain in the rivers throughout the year. Here they grow rapidly, more so than the perfect fish, and their flesh is highly distinguished for its excellence.

A beginning has also been made in regard to increasing the supply of the white-fish in the lakes, and at present I have about three-quarters of a million of eggs, in charge of Mr. N. W. Clarke, at Clarkston, Mich. A portion of these, as soon as they have developed sufficiently for the purpose, I propose to transmit to the Commissioners of Fisheries of California, for introduction into the waters of the Pacific coast, and another year to take measures for multiplying them largely throughout the great lakes. From its situation and size, Utah lake appears well adapted for the introduction of white-fish and land-locked salmon, and I propose to try the experiment, this season, with both species. I may say, in conclusion, that in all the work I have hitherto prosecuted, I have had the hearty co-operation and concurrence of the Fish Commissioners of the several States, it being, in my judgment, the best policy to work with and in a large part through them.

The fund appropriated by Congress is not sufficient to meet all the expenses of the business, especially that of hatching out and distributing the young fish; and I have therefore thought it best to limit my efforts to obtaining the eggs in sufficient quantities and then to turn them over to the State Commissioners, exercising the privilege

of carrying the subject to its entire conclusion in the waters of such States as have not yet appointed Commissioners.

The efforts of the United States in reference to the introduction of useful food fishes should not be limited to the salmonidæ already mentioned (to which the various species of trout, salmon, white-fish and smelts belong) and to the shad, as many other kinds yet remain for consideration. The land-locked salmon, the European char, and the smelt, will be available for all ponds or lakes of a certain extent and temperature. In these they will pass the greater part of their time, running up into the tributaries or outlets to spawn. The great Danube salmon, which sometimes reaches the weight of 100 pounds, would find a perfectly suitable residence in the Mississippi river and its tributaries, feeding on the worthless chubs, suckers and cat fish so abundant therein. The alewife can be propagated to a much greater extent than at present. The sterlet, a kind of small sturgeon found in the Volga and in Russia, is esteemed far beyond the turbot, will thrive in the Mississippi valley and in the lakes. The gourami, an East India fish, can be placed to great advantage in the mill-dams, ponds, etc., of the south, thriving as it does in very warm water and feeding entirely on vegetable matter. It attains a weight of twenty pounds or more, grows with great rapidity, and is unsurpassed in the excellence of its flesh. Other species could readily be mentioned, but I have stated enough to show the prospects before us in the way of increasing, to an almost unlimited degree, the food resources of our country, and in rendering the productiveness of our waters, in this respect, superior, acre to acre, to that of land. Of course, time and expenditure of money will be required, but the larger the scale of operations the sooner and more effectually the result will be accomplished. There is also something still to be done by the United States in the way of extending the area of cultivation of lobsters, crabs, oysters, etc., if not by actual planting on a larger scale, yet by making the necessary experiments and supplying detailed instruction for the work. It is not impossible, indeed, that the great Salt Lake and other interior bodies of saline waters may be made the nurseries of objects such as those mentioned above.

SPENCER F. BAIRD,
U. S. Commissioner of Fish and Fisheries.

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